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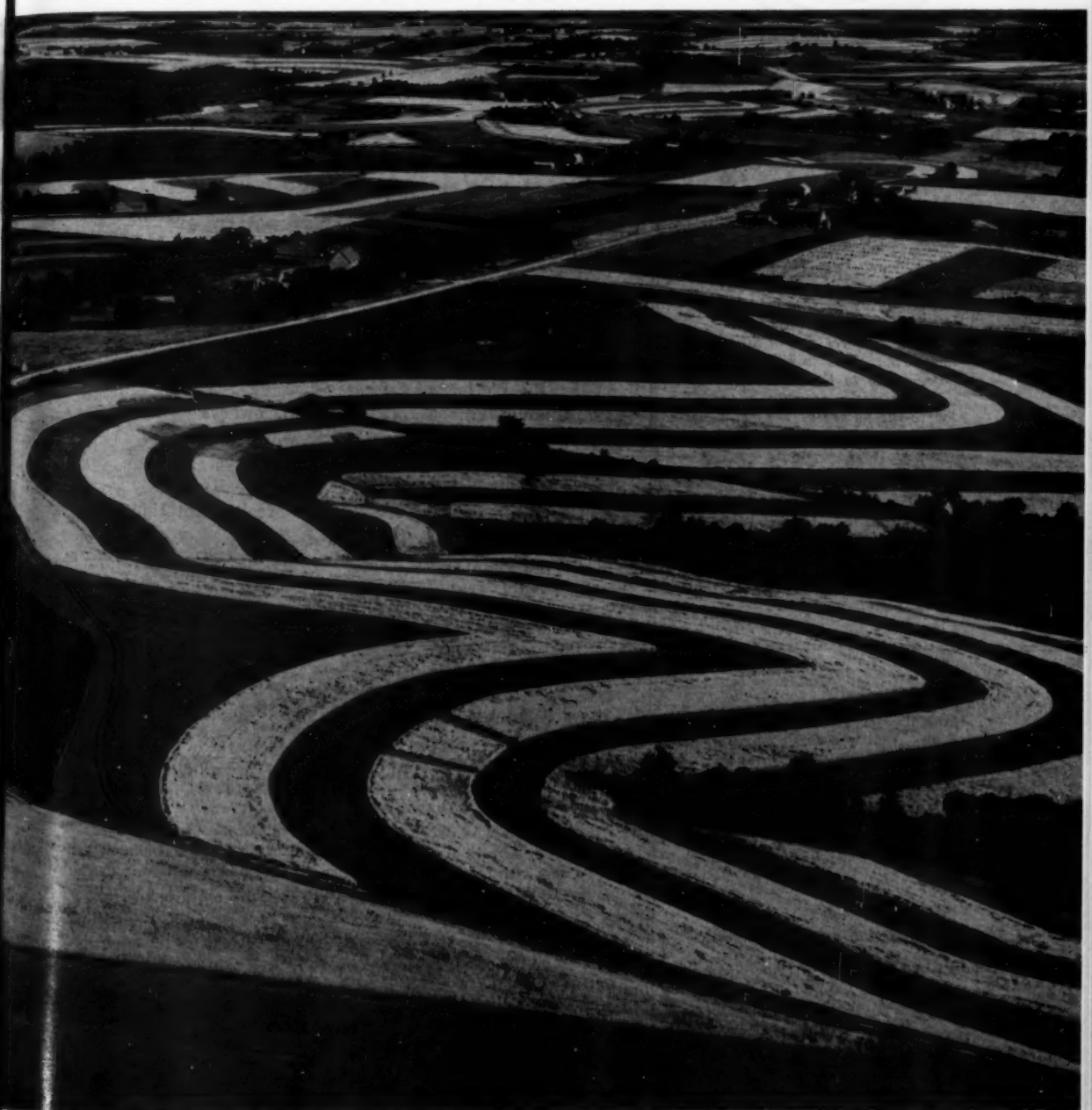
GENERAL INFORMATION

SEPTEMBER 1961

Soil Conservation



SOIL CONSERVATION SERVICE • U. S. DEPARTMENT OF AGRICULTURE

VOL. XXVII, No. 2 SEPTEMBER 1961

Growth Through Agricultural Progress

"Whatever pains we take, whatever expenses we incur, in collecting instruments of husbandry, in accumulating and applying manures, and in tilling the earth; all is to little purpose, unless to these we superadd a succession of crops, adapted to the nature of the soil."
—SOLOMON DROWN

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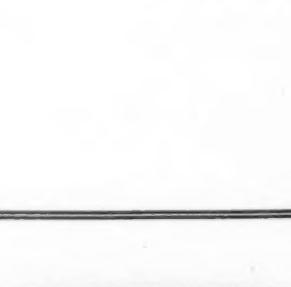

COVER PICTURE.—These farms in the Monroe Co., Wis., Soil Conservation District illustrate good conservation cropping systems combining contour stripcropping and grassed waterways with crop rotations.

Soil Conservation

ORVILLE L. FREEMAN
Secretary of Agriculture

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FRANK B. HARPER, Editor

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Cropland Conservation

By Donald A. Williams

"SOIL management" are two key words in soil and water conservation on croplands.

We make soil surveys to learn the nature of the soil and of land slope, erosion, and other factors affecting its producing abilities. Soil surveys and water relationships are the basic starting points in conservation. We manage and store our agricultural water, by use of irrigation, drainage, ponds and reservoirs, terraces, and other structures, and especially in the soil itself. This water is the life of the soil. And we develop crop varieties, grass, and trees that will grow best on different soils. Such plant development and adaptation are essential to best use of the land for production of food and fiber, and for erosion control and conservation land use.

Soil management is the means by which we bring soil, water, and plants together in a natural and harmonious partnership that best serves cropland needs. It is not just some new agricultural technology. It is as old as the days when American Indians buried fish alongside their planted corn kernels to assure their germination and growth. It is as old as the time of George Washington and Thomas Jefferson, who grew "lucerne" and peas to improve the soil on their Virginia plantations. It is as old as the generations of later-day tobacco growers who burned brush on their seedbeds to kill weed seed.

Soil management is the same in principle as it always has been; but it is vastly different in modern agricultural practice, with the benefit of soil, water, and plant conservation and other refinements of scientific agricultural technologies.

We still plant fish with our corn, but as a scientifically processed ingredient of some of the numerous commercial fertilizers used, in addition to barnyard and green manures, to improve crop production. We still grow alfalfa and peas, but they are only two among an almost endless variety of improved legumes and grasses, adapted to specific soil conditions, that today's farmers grow for soil improvement, conservation land cover, and forage. And we still eradicate weeds in our tobacco beds, and everywhere else they interfere with cropping; but we do so by using chemical weedkillers, weed-free seed, and special tillage and cropping methods.

The ability of any soil to respond to conservation management is determined by its inherent characteristics; so we must fit management to the soil and water situations. Thus we can apply organic matter and fertilizers to increase available plant nutrients for our crops; but it is not easy to change the depth of the topsoil layer which crop roots must have above hardpan or bedrock. We cannot change the steepness of slope; but we can, in effect, shorten its length, by using such conservation measures as terracing, contour stripcropping, cover cropping, and residue management.

The effectiveness of conservation soil management rests upon a combination of improvement and protection measures. Each must support the others. A system of crop strips, for example, is no better than the crop rotation that it comprises. Planning a conservation cropping system to fit the soil's and the farmer's needs is just as important as designing an engineering structure. Specifications for conservation treatment of cropland accordingly are based on soil conditions, moisture relationships, climatic influences, and the landowner's economic and other needs.

How the farmers and ranchers of the United States have been turning the principles of conservation to their own and the land's advantage is reflected in such measures as those now being applied on croplands in soil conservation districts: Approximately 100 million acres of conservation cropping systems, 40 million acres of contour farming, 22 million acres of cover cropping, 75 million acres of crop-residue use, 17 million acres of stripcropping systems, and 18 million acres of stubble mulching.

A high percentage of farmers obtain most of their income from cropland, either in cash crops or in feed for livestock. Others obtain their income from orchards, vineyards, and small fruits. What the future holds for them as producers and for all of us as consumers will depend to a large extent on their conservation use and management of all of these lands. For all of us, too, the degree to which water infiltrates into the soil and is detained on the surface greatly influences the rate of siltation of our streams and reservoirs and the damages from uncontrolled waters.

Georgia Farmers Like Grass-Based Rotations

By L. R. Payne

OLD prejudices against grass on cropland are fast disappearing in the South as farmers with modern equipment have learned how to use grass in their crop rotations and experienced its many benefits.

In Georgia, for example, the greater part of the row-crop land is in the Coastal Plain. Farmers in this area are growing tobacco, corn, and other crops successfully in coastal bermuda and bahia grass sods. The grass reestablishes itself following the row crops.

C. F. Morris, who operates a large tobacco and dairy farm in Appling County, was one of the first Altamaha Soil Conservation District cooperators to take a chance on such a "radical" practice as growing tobacco and cotton in coastal and bahia sods. He found that anticipated difficulties in cultivating did not materialize.

Bermudagrass recovery in corn where row crops and grass have alternated 6 years.

"Our crops were grown under drought conditions from 1953 through 1956, and the crops in grass held up better than the crops not in grass," Morris said. "Then we had wet seasons from 1957 through 1960. We found that the crops also held up better in grass during the wet seasons. We have learned a lot about land preparation for sod planting. This year we cross-harrowed three times to cut up the sod, subsoiled, and made a furrow with an opening plow and planted. This let the grass come back without losing the stand. Once or twice before, we had killed the stand by overdoing the land-preparation job."

Morris reported that his 5 acres of tobacco grown in coastal bermuda sod in 1960 averaged 2,442 pounds an acre and brought an average return of $1,511 an acre.

The system generally followed is to grow one crop of tobacco, corn, or other row crop in a 3- or 4-year sod. The grass is allowed to become reestablished after the last cultivation. Thereafter, a row crop is grown every second, third or fourth year. Various methods of land preparation are used. Most farmers do some harrowing to cut up the sod, turn the land with a moldboard plow or tiller, and harrow again to give a smooth seedbed.

Soil Conservation Service technicians have found the best way to plant in coastal or bahia sod is to put the corn right in the sod with a mulch planter. It mixes grass stubble and soil in the middles and forms a water-holding mulch that helps keep down weeds and grass until the corn is well along. This method also eliminates land breaking and harrowing and saves $8 or $9 an acre in land-preparation costs.

District Cooperator C. F. Morris (right) and SCS Soil Scientist Erwin Iseley examine bahiagrass sod being turned for planting field to tobacco.

In a study of the organic-matter content of soils on the Morris farm in 1953, they found that soil with a 4-year sod of bahiagrass contained 15,000 pounds of dry organic matter to the acre. After one crop in this sod, the soil contained 10,000 pounds of organic material. After a second crop, when the grass had been completely killed out, the soil still contained 7,500 pounds of organic material an acre. These high organic-matter volumes compared to only 3,000 pounds an acre on similar soils in continuous cultivation without sod.

One of the principal crops in the Georgia Coastal Plain is cigarette-type tobacco. It had become difficult and expensive to produce a good tobacco, because of root-knot nematodes and diseases prevalent in the tobacco belt. Growers now grass is virtually disease free and are finding that tobacco grown in

Note:—The author is area conservationist, Soil Conservation Service, Soperton, Ga.

does not require fumigation as commonly practiced. Grass-rotation tobacco also brings top prices. These benefits are most important to growers of a crop that grosses $800 to $1,500 an acre on acreage limited by allotments. Morris figures that growing tobacco in grass saves him $20 an acre in his fumigation bill alone, and cuts his hoeing costs in half.

James Graham, cooperator with the Altamaha district, has been growing crops in grass for 5 years. In 1960 he used a lister planter for planting 45 acres of corn directly into coastal bermuda sod without land preparation. A severe drought damaged crops in Graham's community, but his corn suffered little apparent damage.

"I never expect to grow corn any other way," he commented.

W. V. Head in the same district has found that dairying and grass-based rotations just naturally go together. He uses his grass for grazing and hay production when it is not in row crops. His land is out of forage production only about 6 months every second year when

Coastal bermudagrass (foreground) coming back in tobacco rows.

row crops are growing on it.

"The grass coming out under the tobacco holds the lugs or bottom leaves off the ground and keeps them from sanding or burning," Head pointed out. "We get a couple more lugs to the stalk, and that means money in the pocket. In addition to good yields of disease-free tobacco, we save a $10-an-acre hoe bill, and get 2 or 3 months' grazing after the tobacco is harvested."

H. G. Miles, another Altamaha district cooperator, kept detailed records in 1956 showing that tobacco planted in grass produced 2,345 pounds of tobacco an acre and gave him an average return of $1,248.62. Where the tobacco was not grown in rotation with grass, the yield was 1,647 pounds, with a return of only $887.57 an acre.

Chairman K. C. Mayers of the Altamaha district board of supervisors, who grew his second crop of tobacco in bahiagrass in 1960, commented that it was "the easiest crop to make I have ever grown." His brother, Ed, reported he averaged 2,640 pounds of tobacco an acre on 8½ acres planted in grass, which brought him an average return of $1,545 an acre.

Along with their sod-based rotations and mulch tillage, farmers in the area are building parallel terraces and sod waterways, and are using other soil and water conservation measures that are bringing them more profits and a better way of life.

Green Thumb Works

In "Thumb of Michigan"

By L. W. Kellogg

COOPERATORS of the Tuscola Soil Conservation District in the heart of the "Thumb of Michigan" are proving what proper soil management can do to improve mediocre yields on many of its thousands of acres of soil with a high yield potential.

Ralph Ackerman is one. Seven years ago, he added 160 acres of mostly loam and silt loam land to the 250 acres he already owned. It is all in Capability Class I, but it was in poor condition when he bought it, because it had not been managed properly.

For many years, it had raised virtually nothing but cash crops, with little residue returned to the soil, and no hay, green manure, or cover crops grown. The few lines of tile that had been installed by hand were not working. As a result of this system of management, the land had been worked wet in the spring and again in the fall when the crops were harvested. These factors combined to destroy the structure of the soil and pack it so hard that water stood in some spots nearly the year around.

"I tried to work up some of the land with a field cultivator to prepare a seedbed for wheat," Ackerman remembers. "But the ground was so hard that the cultivator would hardly make a scratch."

He borrowed a field cultivator that would go into the ground, but

Note:—The author is work unit conservationist, Soil Conservation Service, Caro, Mich.

the tractor couldn't pull it because the ground was so hard. He finally hooked two tractors together and, after working the field twice. got a fair seedbed that enabled him to put in wheat. In the spring the wheat was seeded to a mixture of sweet and mammoth clover. After wheat harvest, the entire field was tiled, using 4-rod spacing. The next spring he plowed the clover down and put in navy beans. The clover stand was not too good that first year, but it provided the most organic material that had been added to the soil in many years.

By April 1961, the soil structure was excellent. This improvement had been brought about in 6 crop years by following good soil and water management practices as outlined by technicians of the Soil Conservation Service assisting the Tuscola district.

Ackerman's rotation includes cover crops after his row crops, and a green manure crop of mammoth clover in oats and an equal mixture of sweet and mammoth clover in wheat. He returns all crop residues to the soil, and fertilizes heavily. Minimum tillage also is playing its part in improvement of the soil structure, by reducing soil packing by heavy equipment.

A sample of Frank Nagy's 90-bushel oats held proudly by daughter Julia.

In 1959, Ackerman's 48 acres of sugar beets averaged 22.5 tons an acre; his corn yields are well over 100 bushels of shelled corn an acre; his oats yield from 125 to 150 bushels, and beans more than 30 bushels an acre. His wheat yields run from 50 to 60 bushels. This increased efficiency in production has been made possible because excess water now moves readily out of the soil, and farming operations can be carried out on time.

"Without a good soil and water management program I couldn't afford to own and farm this land today," Ackerman said.

When Frank Nagy, a Tuscola district cooperator since 1952, bought his 120-acre farm, on which the cropland is mainly Classes II and III, the soil was in such poor condition it produced principally mullein and milkweed. The first year, he put in 4 acres of corn and harvested a total of 50 bushels, mostly nubbins. Seventeen acres of oats produced about 25 bushels. Even the hay crop was so poor that he raked as many as four 7-foot swaths into one windrow for baling.

"I knew we had to do something if we were going to make a living on this land," Nagy said. "We could raise practically nothing at first. In fact, I worked in town to help make ends meet."

After following out his soil and water conservation plan for several years, Nagy is obtaining oat yields averaging 90 bushels an acre with a test weight of 38 pounds, 60 bushels of shelled corn to the acre, and a hay crop so heavy that last year the baler would handle only one 7-foot swath.

Soil tests on his crop fields showed they all needed lime and were low in phosphorus and potash. He limed fields as rapidly as he could, and started using high amounts of complete fertilizers. He plowed down all the clover and other organic materials that he could work into his cropping system.

Ackerman now follows a 4-year rotation of corn, oats, and 2 years

Ralph Ackerman and son, Lyle, study excellent soil structure resulting from conservation management.

of alfalfa-bromegrass meadow. His 33 dairy cattle produce a lot of manure, which he spreads on meadowland that is to go into corn the following year. He applies 450 pounds of 12-12-12 fertilizer on the oats, which are seeded to alfalfa-brome. Then he topdresses the second-year meadow with 600 pounds of 0-20-30.

◆

Cover crops are especially good insurance against soil blowing. A Grafton, N. Dak., farmer uses a cover crop on summer-fallow ground on which he plants beets in the spring. Between September 1 and 5, he seeds oats, or treated wheat and barley left over from spring seeding, at the rate of ½ bushel an acre. The next spring, he plants beets into the cover crop, with assurance the young beet plants will not be blown out and will get off to a good start.

◆

Growing 2 rows of corn at 75- to 150-foot intervals on loam or sandy soil on a 70-acre fallow field helped to control wind erosion and catch snow at the North-Central Branch Experiment Station near Minot, N. Dak. The 75-foot spacing was more than adequate for holding snow for storing soil moisture; but the 150-foot spacing, while appearing to control wind erosion, allowed the snow to drift and exposed bare strips of fallow.

Cutting Down on Cropland Soil Compaction

By A. W. Cooper

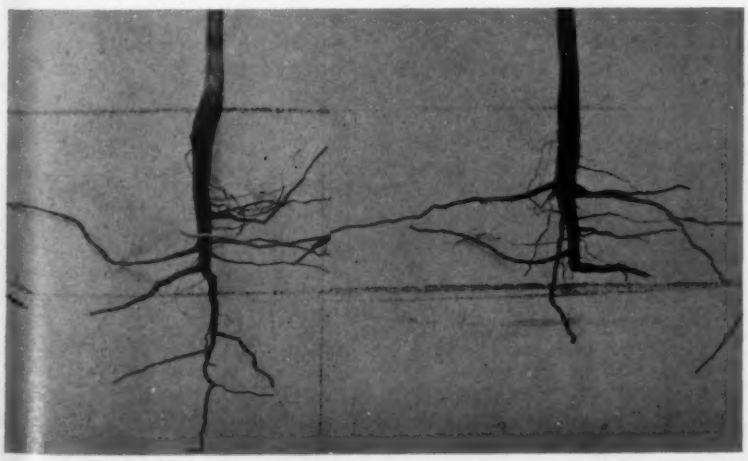
FARMERS and farm machinery manufacturers as well as soil scientists and agricultural engineers have given serious attention to the problem of soil compaction that has been increasing in recent years because of the use of heavier machinery and more traffic over the fields.

Not all compact soil results from traffic forces, however; some dense soils were formed by nature. Much compaction also has been caused by a decrease in organic matter resulting from continuous intensive cropping to row crops, without returning the residues.

In order to decrease soil compaction, we need to understand the forces that cause it, and to combine proper design and use of farm machinery with good soil-management practices.

Compaction, or the increasing of the soil bulk density by the reduction of pore space between the soil particles, affects all life within the soil. It reduces the space available for air diffusion to the roots. It decreases the intake rate and transmission rate of water.

The relationship of the soil's physical properties to plant growth is complex, and it is difficult to determine the extent of crop-yield reduction caused by soil compaction. It is relatively easy, however, to examine the soil to see if a very dense layer has formed just below the normal plowing depth. This layer usually can be located with a shovel. The water-infiltration rate of the layer can be checked by using a cylinder made from a tin can. Water is poured into the can to a depth of 1 inch, and the time taken for the water to enter the soil is noted. The same test can be performed in subsoil simultaneously. If the subsoil takes in the water much quicker than the layer above it, the chances are that there is a compacted layer that should be removed by tillage.



Cotton root on right grown on sandy loam soil with a compacted layer. Root on left grown in same field where compacted layer had been broken up.

No. 65

This is the sixty-fifth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

The most common tillage practice today is to plow with a moldboard or disk plow 3 to 8 inches deep, and then to harrow lightly with a disk harrow to break up the clods. Admittedly, much food and fiber has been produced using this method of tillage, and it will continue to be used. However, we should take a look at our soil condition and plan our tillage practices based on the soil's needs. Under many conditions, we are compacting soils beyond the condition for optimum plant growth. In other cases the soil is naturally dense below the normal depth of plowing.

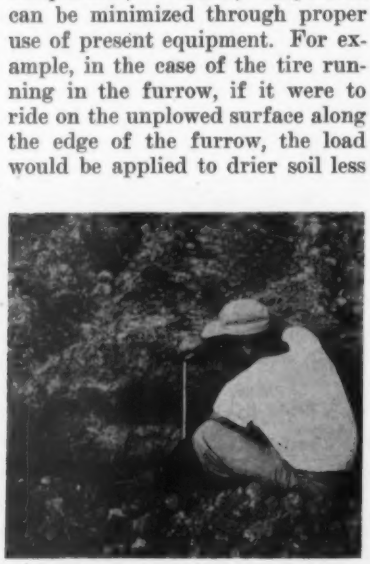
The compaction resulting from a given load applied to the soil depends upon the mineralogical, organic, and mechanical composition, the moisture content, and the initial consolidation of the soil. In general, a cohesive soil with a high percentage of clay or silt will not

The author is director, National Tillage Machinery Laboratory, Agricultural Engineering Research Division, Agricultural Research Service, Auburn, Ala.

compact as much as a sandy loam soil at the same moisture tension and subjected to the same load. Also, some clays are less susceptible to compaction by mechanical loads than are other clays. The moisture content greatly affects the soil's susceptibility to compaction. At low and very high moisture contents the soil does not compact as much as at intermediate moisture contents. But, when the moisture content is high and water is squeezed out, compaction results from smearing, or puddling.

Along with the decreasing pore space, compaction causes an increase in soil strength, which must be overcome by tillage or by the growing roots. A number of studies have shown that a compact soil reduces crop yields. In Louisiana, cotton yields were increased from 1.5 to 2.5 bales an acre by loosening a compacted layer. In California, the yields were increased from 0.5 to 2 bales an acre by loosening a compacted layer in a sandy loam soil.

In some cases, equipment needs to be redesigned to minimize soil compaction; in others, compaction can be minimized through proper use of present equipment. For example, in the case of the tire running in the furrow, if it were to ride on the unplowed surface along the edge of the furrow, the load would be applied to drier soil less susceptible to damage. Also, the greatest part of the soil compacted by wheels would be broken up by the tillage. Here the design of the equipment in most cases must be changed to allow operation of the wheel out of the furrow. The disk harrow is useful for reducing clod sizes, but it has been found to do damage, especially to sandy loam soils, if the soil is harrowed several times before planting.



Compacted layer (light area) between strips subsoiled before 1-inch rain showed few roots, because water did not penetrate it.

Careful driving between rows during cultivation and other tillage operations can reduce the compacted area. Driving in the same tracks minimizes the compaction, because most of the compaction is done by the first trip over the soil.

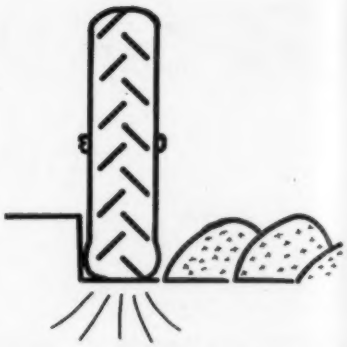
Chisels may be used to break up soil compacted by wheels. Subsoiling and other deep-tillage practices are beneficial, when they sufficiently pulverize a soil that needs loosening. It is important to make careful examinations before subsoiling to determine if the soil needs loosening and, if so, to what depth.

Tillage remains more of an art than an exact science. The use of a shovel is helpful in determining the location of compact layers, and in determining the degree of breakup accomplished by a tillage operation. Where good pulverization is desired to a considerable depth, it has been obtained by taking small cuts at 2-inch increments of depth rather than by subsoiling the full depth desired.

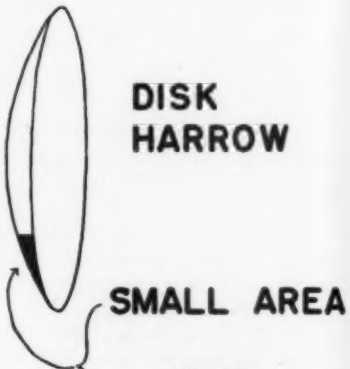
Deep tillage, combined with growing deep-rooted crops like alfalfa, helps improve soil structure. Incorporation of plant material improves soil structure and makes it more resistant to compaction.

We also need a method of tillage in which we do not recompact the soil we have just loosened, and in which the soil is loosened to the depth needed, with the soil under the crop row not compacted.

A deep-tillage study has been initiated by the National Tillage Machinery Laboratory on Lloyd clay loam soil, which is naturally dense from the surface down. The soil is pulverized in strips approximately 18 inches wide and 18 inches deep, on 40-inch centers. The tractor tires operated on firm soil and therefore did not recompact any loosened soil. The soil was prepared in the fall and planted in the spring. A much better stand was obtained on these plots than on the conventionally tilled plots which were plowed in the spring, causing the soil to dry more before planting. Although we are not ready to recommend trench tillage, work is in progress at several locations on various methods of strip preparation of soil; and it has good possibilities as a method of decreasing soil compaction in row cropland.



Tractor tire running in furrow compacts soil below tillage depth.



Mismanaged disk harrow also can cause a compacted layer below cutting depth.

Now Can Sleep Nights—

Gets High Wheat Yields

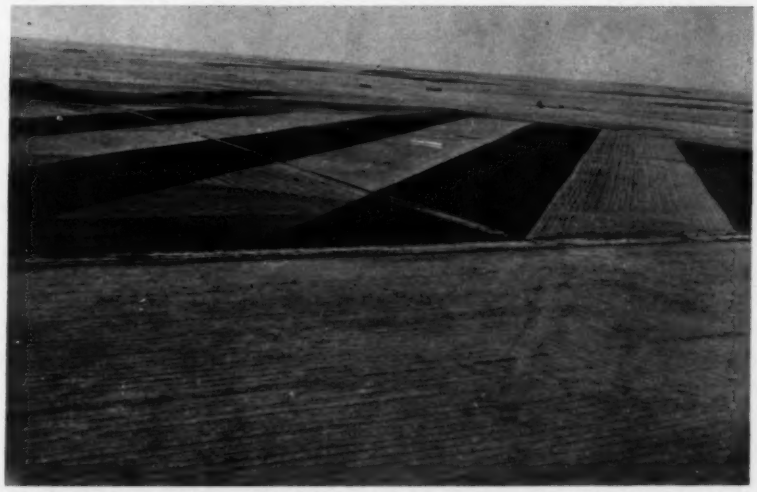
By Walter N. Parmeter

COOPERATOR Ralph Letellier in Sully County Soil Conservation District, S. Dak., credits his consistently high winter wheat yields and being able to sleep nights both to wind-erosion control with stubble-mulch tillage and stripcropping.

"When my summer-fallow fields blew, I couldn't sleep," Letellier said in reporting that during the past 7 years he has had an average yield of 27 bushels an acre on his 500-acre wheat base. "My wheat-yield success has been due to protecting the soil from wind erosion and keeping the residue on the soil."

With the help of the Sully County SCD, Letellier laid out his wheatland in 20-rod diagonal strips at a right angle to the prevailing winds. These strips are rotated, wheat on fallow, each year.

In the fall, soon after the strips are harvested, they are worked with either a chisel or a one-way disk, depending on the amount of fall moisture in the soil and amount of residue and weed infestation, to kill weeds and loosen the soil for rapid moisture penetration. Ralph likes to adjust his one-way to a small angle, cutting just deep enough to kill the weeds, and operates at a speed which will leave the residue partly standing to catch more snow for additional moisture. During the next summer-fallow season, the strips receive two to four additional fallow operations, depending on the amount of rainfall, before planting to 30 pounds of Nebred winter wheat to the acre early in September.



A full 640-acre section of wind stripcropping on Ralph Letellier farm, including two grassed landing strips for this flying farmer.

Wind erosion has been eliminated on Letellier farm with crop residue, rough tillage, and diagonal wind stripcropping.

Letellier also rebuilt his grain drills with large shovels and 20-inch row spacings between shovels, rather than the conventional 14-inch spacing. These drills not only plant the wheat down where there is moisture; they also make a large ridge between wheat rows, that helps prevent wind erosion as well as protecting the wheat plants from winterkilling.

The next spring, when the weeds start growing and the grain usually is 4 to 5 inches high, he uses a rotary hoe to kill the weeds and to break the soil crust. If the weeds continue to be a problem because of frequent rainfall, he sprays the wheat with 2, 4-D.

Growing wheat in 20-inch rows does not produce as high yields in years of ample rainfall as those of the 14-inch rows; but in 1959, a drought year when neighbors were lucky to get their seed back, Leteillier harvested 20-bushel wheat. He consistently has one of the highest wheat yields in Sully County, including in dry 1961.

He believes that the wheat stubble and straw are too valuable to feed to livestock. He says there is

Note:—The author is agronomist, Soil Conservation Service, Huron, S. Dak.

no other material that contributes as much to soil productivity on his wheat farm as the residue he maintains on his land, because it improves the tilth, helps prevent soil erosion, and increases the soil's water- and nutrient-holding capacity.

Letellier is convinced that successful winter-wheat farming in the Great Plains is dependent upon protecting soils from wind and water erosion, and that his stubble-mulch stripcropping system is the answer.

"I am concerned when my seedbed starts drifting across the road," he said. "It is a loss I cannot afford."

Conservation Cropping System Works For Arizona Farmer

By Mervin H. Wallace and Walter E. Parsons

BETTER crops and fuller use of his limited supply of irrigation water are among the rewards Keith Carlton reaps from a long-established conservation soil-management cropping system on the 800 acres he farms in Arizona's Casa Grande Soil Conservation District in Pinal County.

When Carlton bought the 400 acres he operates with two farms he leases, the land needed leveling, and getting effective water penetration on the loam and clay loam soils was a problem. He promptly planted the entire farm to alfalfa, from 1947 to 1949, as a beginning for his conservation cropping system. Through the Casa Grande district, of which he has been a cooperator for many years, he has received technical help from the Soil Conservation Service on land leveling and field layout, irrigation system improvements, water management, and conservation problems related to the management of crops and soils.

His crop rotation consists of alfalfa 3 to 5 years and cotton 3 to 5 years, with 1 year of barley and grain sorghum, which returns a large amount of residue. He also grows Papago peas for green manure at every opportunity.

Carlton uses "rough tillage" when preparing his seedbeds, plowing with a moldboard when the soil is dry enough to turn up cloddy. Plowing depth, to a maximum of 15 inches, is varied each year, to avoid creating plowpans. After a 30- to-90-day aeration period, he floats once or twice, furrows out for irrigation, preirrigates, knocks down the ridges with a rotary mulcher, and plants. He holds his cultivations to a minimum. Cotton usually is cultivated six to nine times, depending upon the weed growth, though one cultivation for each irrigation ordinarily is enough.

About 30 percent of the land in Pinal County is left idle each year because of water shortage, but Carlton is able to crop all of his land every year with water from small wells that produce 3,700 to 4,000 gallons a minute. He is able

Field rough-tilled for preirrigation for 1961 cotton produced 3¼ bales an acre in 1960, first year out of alfalfa.

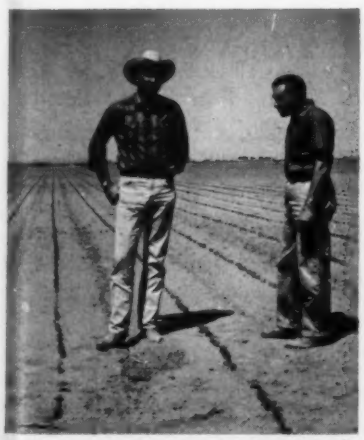
Keith Carlton in 3-year-old Moapa alfalfa being pastured by sheep in February 1961 and to be rotated to cotton in 1962. Field yielded 10 tons of hay an acre in 1960, plus early-season sheep pasture.

Note:—The authors are, respectively, agronomist, Phoenix, Ariz., and work unit conservationist, Casa Grande, Ariz., both of the Soil Conservation Service.

to make his water reach so far because of precision leveling of all except one 40-acre field, concrete lining of all ditches, and diversification of crops so that their competition for water during peak use periods is held to a minimum.

Carlton not only applies his water efficiently to the land, but, because of his conservation cropping system, the crops make the most efficient use of the water. For cotton, he applies about 18 acre-inches of water during the preirrigation. This wets the soil to a depth of 6 or 8 feet. The growing-season irrigations, of approximately 4 inches each, bring the season's water used on his cotton to a total of 42 to 48 acre-inches, compared to the actual consumptive-use requirement for cotton of only about 35 inches. Carlton, a director of the Arizona Cotton Growers Association, consistently raises close to 3 bales an acre, though Pinal is a 2-bale cotton county.

His barley yields of 1½ to 2 tons and grain-sorghum yields of 2 tons or more likewise are well above the county average. In 1960, he raised a small acreage of safflower as an experimental substitute for barley. The field gave him a net return of $46.12 an acre; so he increased the acreage to 80 acres in 1961.



Carlton's (left with SCS WUC Walter Parsons) conservation cropping system keeps soil in top condition for crops like this young 1961 cotton stand.

Field of Papago peas, planted in the fall and plowed under for green manure the next April on Carlton farm, being examined by SCS Soil Conservationist Ted Karns.

Instead of following the usual practice of missing two cuttings by withholding the water during July and August, he irrigates his alfalfa straight through those months, and averages around 10 tons an acre, in addition to getting one or two pasturings for sheep in the spring.

Carlton will tell you the reason many of Pinal County farmers' cotton yields are dropping is that they overwork the land and do not keep the soil in good physical condition. He has demonstrated, for example, that water intake need not be a problem. Most of his fields are leveled to 1-percent irrigation grade and 1,320-foot runs, though some on the sandy loam soils are only 880 feet long. He is able to irrigate the clay loams with 6- to 8-hour sets, and the loams and sandy loams with 4- to 6-hour sets. He guards against irrigating too deeply, but has found that a small amount of deep penetration is beneficial in preventing salt accumulation in the root zone.

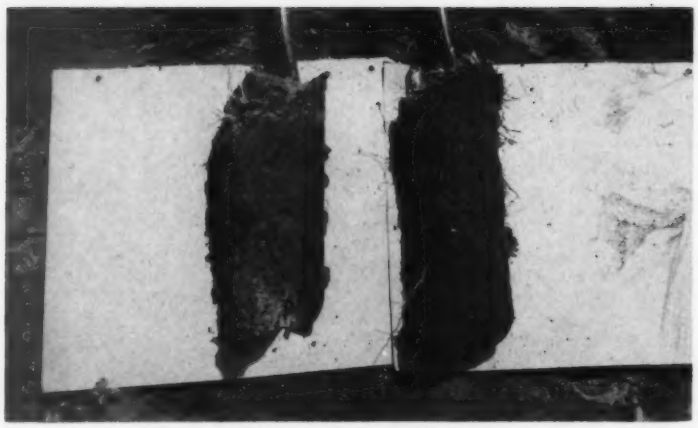
By rotating his crops and making use of green manure and all crop residues, Carlton also is able to cut down on the commercial fertilizers he uses regularly as needed. Together, the vegetative material and fertilizer are important in his soil management system.

"It is hard for farmers to make up their minds to get into this kind of system," Carlton observed after using his own conservation cropping system for 13 years. "The first 2 or 3 years they do well to break even. This is a long-time program, and many farmers do not make long-time plans. Me, I grew up on a farm and knew what a long-time program would do; so I started in as soon as I bought the farm. I wouldn't farm any other way."

He plans further improvements in his irrigation system, to make it still easier to carry out his soil and water conservation program.

◆

District Extension Forester Robert Raisch at Kansas State University lists four major sources of injury to windbreaks: Weed competition, insect-disease attacks, damage by livestock and rodents, and fire. Some precautionary measures he recommends are: A 15- to 20-foot fire lane, or isolation strip, to guard against fires; a clean isolation strip for outside row cultivation, to hold down weed growth; preventing soil compaction and grazing; and checking windbreaks every few days during the summer for insects.



Poor tilth (left); good tilth (right).

Spreading lime and fertilizer.

Crop-residue management.

Soil Manage

Conservatio

By B.

1. Maintain Proper Air and Wat
Irrigation, drainage, timely tillage, c

2. Maintain Balanced Supply of
Commercial fertilizer, barnyard manu

3. Maintain Optimum Soil Reacti
Lime, gypsum, leaching

4. Maintain Proper Soil Tilth.
Crop residues, proper tillage, green ma

5. Reduce Runoff and Control Ero
Contouring strip crops, terraces, gras
ment, minimum tillage

6. Control Insects, Weeds, and P
Crop rotation, timely tillage, chemica

Cultural, management, and mechanic
ing these principles. They must be
kinds of soil, as their full effects depe
one another.

Note:—The author is head agronomi

...gement Principles ...r ...tio... of Cropland

By B. ... Blakely

...nd Wat...lationships in the Root Zone.
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...ust be u... in the right combinations for different
...cts depe... on the relationships and interactions with

agronomi... Conservation Service, Washington, D. C.

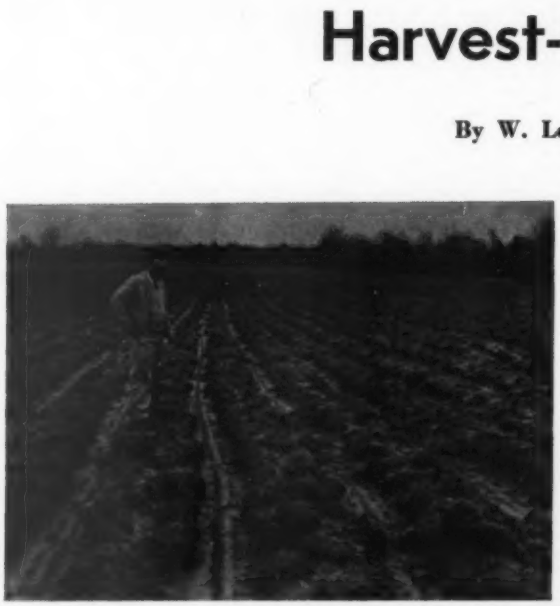
Cover crops.

Stripcropping.

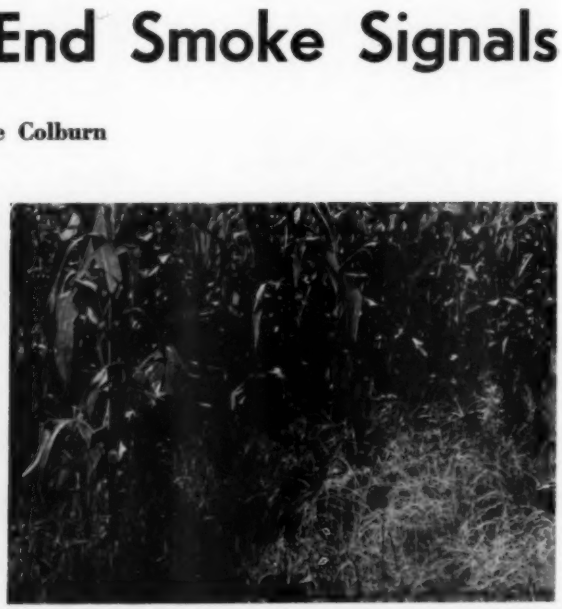
Grasses and legumes.

Mulch Tillage Stops Harvest-End Smoke Signals

By W. Lee Colburn



Corn planted in coastal bermuda sod on Lugoff farms, Kershaw (S. C.) SCD.



Recovery of coastal bermudagrass after last cultivation.

Cutting corn for silage. Planted with lister planter and cultivated twice.

Bermudagrass ready for grazing again. Note corn stubble in grass.

A FEW years ago a sure sign that a farmer in the Coastal Plain of the Southeastern States had finished his small-grain harvest was a black cloud of smoke boiling toward the heavens and visible for miles.

Today, more and more soil conservation district farmers across the Coastal Plain complete their grain harvest and have another crop planted on the same land before anybody knows it. They burn no residues before planting—no smoke rises in the sky.

The reason for this change during the last 5 years or so has been their adoption of mulch tillage, a form of minimum tillage consisting of planting certain row crops in previous crop residues, cover crops,

Note:—The author is area conservationist, Soil Conservation Service, Bishopville, S. C.

or established sods without prior land preparation. A planting furrow is made, and all material on the surface of the soil is moved to the row middle and covered.

Manager George Lachicotte of Lugoff Farms in the Kershaw Soil Conservation District in central South Carolina is a firm believer in this method of planting. The Lugoff Farms operation consists of three different types of farming—raising beef cattle, running a large dairy herd, and growing row crops that produce feed for the livestock.

"We know this method of planting and cultivating has many advantages over conventional planting and cultivating as used before mulch tillage was developed," Lachicotte said. "After trying this method of tillage, I wouldn't plant some crops by any other method. Today we plant and cultivate over a thousand acres by this method. This consists of corn in soybean stubble, soybeans in small-grain stubble, and corn for silage in grain stubble."

Last year, for the first time, Lachicotte planted ensilage corn in a field of coastal bermudagrass sod, using the mulch-tillage method. This 50-acre field had been in coastal bermudagrass and grazed for the past 7 years. Lachicotte figured that it had become slightly sod-bound and needed renovating. Despite having to replant because of heavy rain and then a cool spell after the first planting, he was well pleased with the results.

He applied 1 ton of lime and 400 pounds of 18-percent superphosphate to the acre before planting the corn with a 4-row, lister-type planter, and used 500 pounds of 4-12-12 fertilizer an acre at the time of planting. The placement of fertilizer at time of planting is the main problem he has encountered, but he believes that with the equipment companies working on it, placement soon no longer will be a problem.

The corn was cultivated twice, with 125 units of nitrogen applied at the last cultivation. He was very careful not to disturb the sod in the middle during the first cultivation. The middle was leveled with the row when the second cultivation was made, leaving a nearly level field. The ensilage yield was about 18 tons an acre.

Three weeks after the ensilage was harvested, the coastal bermudagrass had made a complete recovery, and the beef herd was allowed to graze on it until frost. Today, the soil in the pasture is loose and friable, and the grass is more vigorous and abundant than ever.

Pointing out that the cost of each operation on the Lugoff Farms is carefully itemized and recorded, Lachicotte said the records showed a saving of $9.70 an acre in land preparation alone by using mulch tillage.

"Another advantage over conventional tillage," he explained, "is that this method permits us to plant our crops on time. A farming operation as large as ours means that we have to make the most efficient use possible of our tractors. By not having to prepare our land prior to planting, we can use the tractors that would be breaking land on some other job."

Other benefits from mulch tillage he has observed include: Conservation of moisture at planting time, less "lodging" of corn, and better grass and weed control. His yields from crops grown by the mulch-tillage method were equal to or better than from those grown by the old methods of cultivation.

Stubble Mulching

For California's Hillside Fields

By Adrien Kuffer

STUBBLE mulching holds promise of providing a solution to sheet-erosion problems on hillside fields in the Half Moon Bay area along the California coast.

Leastwise, that is the opinion of Elbert Marsh as a result of his experience in conservation farming of 2,000 acres of grain, flax, vetch, peas, and hay. He also has irrigated and dryland pastures used for feeding out replacement heifers. Marsh has learned that he can't afford to spend time reseeding and repairing eroded fields, if he is to plant and harvest on schedule.

For this reason, he has been working with directors of the San Mateo Soil Conservation District and Soil Conservation Service technicians assisting the district in developing techniques of grain stubble mulching. This practice is designed to control the annual topsoil losses from water erosion and gullying when hillsides are farmed. This soil loss has been of great concern to the district directors.

Early-fall stubble mulching is elminating sheet erosion like this in most cases.

Note:—The author is work unit conservationist, Soil Conservation Service, Half Moon Bay, Calif.

Elbert Marsh finds no erosion and new seedlings coming through after heavy rain on his cloddy, heavily straw-mulched field.

Actual measurements by Soil Conservation Service technicians have shown a soil loss of as much as 525 tons an acre on severely eroded areas. After 3 years of experience, Marsh has found that by using stubble mulching, his soil losses from high-intensity storms have been reduced to a minimum. He has been so impressed with the results that he increased his few mulched acres of the first year to 300 acres the second year, then to 650 acres this year.

Briefly, the reason for Marsh's interest in this practice is that, in addition to conserving his soil, he has been able to reduce considerably his equipment working hours and more nearly meet his planting schedules. He says that, by using the same tractor, he has been able to reduce the first operation by about half the time; that is, he uses a disk that works an acreage twice as great as the acreage worked by his plow. Then, too, because of the improved tilth of the soil, he finds that less power is required to prepare the seedbed and to do the seeding.

No weed problem has developed. The seedbed preparation technique he uses calls for disking just before seeding, to kill the young and germinating weeds. Marsh has found that the soil holds moisture better, that there is less packing, and that light rains are of greater benefit than where a clean seedbed is prepared.

Mulching as practiced on the Half Moon Bay coast requires no special machinery. Farmers are using the same equipment which has been used for their customary practice of land preparation and seeding—a disk for mulching and a drill and roller for seeding.

Marsh was selected by the San Mateo district directors as Conservation Farmer of the Year for 1956, because of his continuing to practice and improve the technique of grain stubble mulching.

Marsh (left) and SCS technician Howard Chipps deplore gullying and sediment at bottom of field clean-cultivated for seedbed.

Protecting the hills of Half Moon Bay, Bob Machado is disking across the slope and leaving a mulch cover of about 1,500 pounds of straw an acre.

Use Mulch

Extension Horticulturist E. C. Wittmeyer, Ohio State University, reports that mulching will do a better job of controlling weeds and reducing water-evaporation loss and runoff after heavy rains on some crops.

Rotted manure, partly decomposed compost, weathered sawdust and shavings, peat moss, and ground corncorbs can be applied about 2 inches deep. Straw needs a deeper application. One inch of sawdust to reduce soil moisture may suffice, but the weed control may require more; and perennial grasses are difficult to control with mulch.

There may be a deficiency of available nitrogen when straw, shavings, sawdust, and ground corncobs decompose. Therefore, fertilizer such as 12-12-12 or equivalent, at the rate of about 1½ pounds, or ¾ pound of ammonium nitrate to 100 feet of row for rows 3 feet apart, may need to be applied several times, depending on the mulch and crop conditions.

Soil Management Boosts Wildlife

By E. R. Minnich

YOUNG E. B. Matthews of Lawrenceville, Va., discovered a new place for wildlife food and cover when he noticed in planting a 6-acre field to corn that one row was omitted in each terrace channel.

This was done in order to leave a strip 6 to 8 feet wide for waterflow during hard rains. He immediately decided that, as there were five well-distributed terraces in this field, this strip might be usable in his farm wildlife program, by preventing the terrace channel from washing and providing wildlife food and cover.

E. B. requested wildlife seed through his 4-H Club adviser and the Southside Soil Conservation District, and was furnished a few small bags of milo seed. After preparing a good seedbed, he seeded each terrace channel, broadcasting the seed to give thick, even distribution.

After the corn was harvested in early November, the cornstalks were cut into the ground with a disk, as a part of the seedbed preparation for small grain in the planned field rotation. E. B. asked the tractor operator to leave a couple of the cornstalk rows on each side of his milo strips, to add additional cover for the winter.

When the hunting season opened in the fall of 1960, E. B. got his dog and gun and set out to see the results of his terrace-channel wildlife strips. He was rewarded by finding three coveys of quail on his first visit to this 6-acre field Throughout the entire hunting season, each trip to the field yielded game.

The farm has a large number of terraced fields. When the land in these fields is plowed for a row crop like corn, a careful job of terrace maintenance always is done. The terraces on the steeper fields usually are difficult to combine. When hay follows small grain, the terraces are worked down to permit ease in haymaking. After these milo strips had served their purpose, the terraces were reworked and seeded to the same hay mixture as the rest of the field.

Food and cover for wildlife: Cowpeas in odd corner; Milo on terrace ridge; 1 row of corn; wheat in field. Result—3 covey of quail and other small game on the 10 acres.

The present-day land-use program in Brunswick County shows a trend toward more woodland. Quail and rabbit are increasing. The hunter's problem today is to find the game in areas suitable for good shooting. The terrace-channel strip-seeding idea placed into effect by Matthews served his wildlife program in two ways. It provided food and cover for the game, and at the same time placed it in a spot suitable for good shooting.

E. B. has many other good wildlife practices on his farm. He seeds annual game-bird mixtures in several patches along the powerlines that cross the farm. He seeds another annual mixture on the tobacco-plant beds after the crop has been planted. He has seeded a mixture of perennial grasses and legumes on the borders between the crop fields and woodland areas, and he seeds field peas and soybeans on many odd corners and short-row areas that are created in his contour-tillage operations.

Note:—The author is work unit conservationist, Soil Conservation Service, Lawrenceville, Va.

Kentucky Farmers Go for

Grass Cover Crops

By Walter J. Guernsey

SEEDING cover crops at the last cultivation of row crops is gaining favor with Kentucky farmers as it is with progressive farmers in other lower Corn Belt States. They like that extra growth they get before winter.

Cover crops have been seeded successfully at the last cultivation in corn, soybeans, grain sorghum, and truck crops.

As early as 1953, quite a few farmers in western Kentucky were seeding KY-31 tall fescue successfully at the last cultivation of corn. Farmers in Livingston County and elsewhere planted fescue in standing corn with a cyclone seeder before the last cultivation, giving this cover crop several weeks' jump over those seeded after corn harvest. Annual ryegrass also has been planted successfully at the last corn cultivation.

A cover crop regularly would be seeded after corn harvest, about October 20 to November 1, in this area; but when it is seeded this late, it makes very little growth, and usually is damaged severely by freezing and thawing during the winter. On the other hand, KY-31 tall fescue seeded at the last cultivation has made from 3 to 24 inches of top growth by December 1, depending on weather conditions, site, and fertility. The root system is correspondingly well developed and may extend as much as 12 to 15 inches into the soil. KY-31 tall fescue also is less susceptible to winterkilling than is ryegrass.

Another grass that shows promise in field tests in Kentucky is field brome, *Bromus arvensis*, an annual, which has been used with success in other States like Massachusetts, Ohio, Michigan, and Indiana.

Small grains have been popular as winter cover and green manure crops for many years. However, grasses produce several times more pounds of roots in the upper 8

Crop	*When sampled*	*Dry weight of roots in pounds per acre*
Field brome	Late spring, established previous summer or early fall	3,000-8,000
KY-31 tall fescue	Fall, second year	6,500
KY-31 tall fescue	Late spring, established previous summer or early fall	2,500-6,000
Oats, winter	At maturity	600
Rye	Bloom stage	2,000
Ryegrass	Late spring, after establishment in corn previous year	2,000-8,000
Vetch, hairy	Late spring, seeded previous fall	1,000
Wheat	Bloom stage	800

Fescue seeded at last cultivation of corn on Junior Morgan farm in Wolf County was 10 to 15 inches tall by November and improving soil tilth and structure.

Note:—The author is agronomist, Soil Conservation Service, Lexington, Ky.

inches of soil, the plow layer, than do the small grains. The tabulation shows data collected from different sources on the approximate yield of roots of various crops in the 8-inch plow layer.

Small grains likewise have not proved as satisfactory for seeding at the last cultivation of row crops as have grasses. This seeding date is earlier than normal for rye and other winter grains, and they tend to become diseased and develop seed stems before cold weather, making them more easily winterkilled.

There are other reasons why grasses are preferred over small grains:

Grass plants use large quantities of water when growing vigorously in the spring, 8 months after seeding. The larger the root system and leaf-surface area, the more water that is removed, and the earlier the land can be plowed Grass cover crops, because of their greater production of roots and tops, will help maintain and improve soil tilth or structure, add organic matter, and make the soil more friable, or crumbly, and thus easier to work.

Grass seeds are smaller than those of small grain; and, with more plants to the square foot, combined with the natural spreading habits of grass plants, a better and more complete ground cover results, and erosion from raindrop splash is greatly reduced. On bottom land subject to overflow, soil is protected by grass against scouring or surface erosion throughout the winter and early spring. Loss of fertilizer nutrients through leaching is kept to a minimum when the soil is covered with a vigorous grass cover crop.

Cover crops have been seeded successfully at the last cultivation on both bottom land and upland. Until recently, however, small grain was the winter cover crop most generally used, and small grain usually cannot withstand frequent or continuous flooding during the winter months, or for more than about 10 days. Ryegrass, on the other hand, can stand approximately 3 weeks of overflow without damage during the winter, if the water is moving. KY-31 tall fescue, under similar conditions, has withstood 5 to 6 weeks of flooding without damage.

By using this method, many acres of Kentucky's cropland that once remained bare through the winter season now are being protected and improved.

Minimum Tillage Licks "Goose-Drowners"

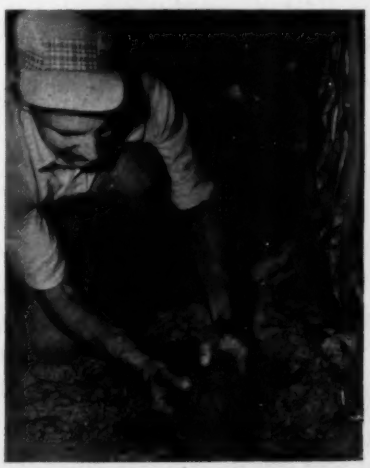
By Glen E. Bernath

SUMMER cloudbursts can leave northwestern Ohio's flat fields looking like rice paddies. That's fine for rice, but the main crops here are corn, soybeans, and tomatoes.

"We always had these summer goose-drowners," Paul Stockman, whose farm is near Napoleon, recalls. "Now we have found a way to handle this water to our advantage."

Stockman, a supervisor of the Henry County Soil Conservation District, and his son, Paul, Jr., farm 180 acres of this level, fertile soil, which has a high clay content and a constant tilth problem. Their land is typical of that in northwestern Ohio and large sections of many midwestern States.

Ryegrass cover crop before minimum tillage. (Left to right: Paul Stockman, Sr., Paul, Jr., and SCS WUC James Huff.)



Paul, Jr., likes feel of season-long friable soil in wheel-track planting in narrow-row corn trial.

The Stockmans decided to try wheel-track planting after reading that they could save $4 an acre in putting in crops. They did. Their biggest surprise though, was the elimination of the surface-water problem after the first heavy rain.

Note:—The author is agronomist, Soil Conservation Service, Defiance, Ohio.

The wheel-track planting left the surface soil in a condition that permitted rapid infiltration of water.

The real test was a rainstorm that left water standing for 24 hours on adjoining fields that had been planted in compacted soil with the customary tillage. After 1 hour, no water was standing on the wheel-track-planted field. Both fields are well tiled, but if the water can't get into the soil, the tile serves no purpose. Now, after using minimum tillage for 3 years, the Stockmans are convinced that their loose, open surface soil will take about any rainstorm the weather has to offer.

Minimum tillage is a principle: Work the soil as little as possible to obtain a satisfactory crop stand. The Stockmans wait until planting time, then do a good job of plowing. They have 4-row planting equipment, which requires setting the rear wheels of the tractor in, to 40 inches, putting extensions on the rear axles, and attaching two additional wheels. All of their row crops, about 100 acres of corn and soybeans, are planted with the wheel-track method.

Loose, open soil that takes in water from intense rainstorms.

Their minimum-tillage idea does not stop with the planting operation. Because they use pre-emergence weed spray, cultivation during the growing season has been reduced or eliminated. They grow cover crops on land that otherwise would be bare over winter.

Last year, the Stockmans entered the local 5-acre corn-yield contest. They wheel-track planted the corn, sprayed, and left the field until harvest. The corn yield was 120 bushels an acre, in the top yield range for these soils.

"We are completely sold on the benefits of minimum tillage," Stockman says. "In addition to higher yields with less labor now, we expect to realize long-time benefits from this practice in future years."

Wheel-track planting on the Stockman farm.

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A total of 10,248,000 pounds of grass and legume seed was exported from the U. S. in October 1960, the highest for any single month on record. Also, the total of 22,562,000 pounds shipped abroad from July through October exceeded all previous 4-month totals. Bigger October shipments to France, West Germany, the Netherlands, and Italy accounted for the increase.

◆

Seventy percent of the crop varieties now grown in the United States were unknown 20 years ago.

You Can Depend on

Orchards on the Level

By Joseph J. Voschin

BROTHERS Carlton and Howard Heritage have as their main objective raising top-quality fruit while building up the fertility of the soil on their farm in the Richwood orchard area of New Jersey's Gloucester County Soil Conservation District.

The Heritage brothers, along with their two sons, operate 180 acres, mostly in peaches. Howard and his son, Howard, Jr., have been doing all of the orchard work; because Carlton has his hands full as President of the New Jersey Farm Bureau, though his son, Reed, in high school, works on the farm summers and weekends.

The Heritage brothers' first contour orchard was laid out and established in 1945 when they became district cooperators. Since then, all new orchards on their sloping land also have been planted on the level. Both brothers have observed that the water-holding capacity of the soil has increased tremendously over the years. They feel that the contouring, along with better use of fertilizer and cover crops, has brought about these good soil conditions. They figure that these benefits far outweigh the inconvenience of spraying the curved rows.

In 1957, during the worst drought recorded by the Weather Bureau in this area, they dug an irrigation reservoir. Water was applied at the rate of 10 gallons a minute for 5-hour periods before the portable pipe was moved, without any signs of soil movement. For the Aura soils on their farm, which have a notoriously low infiltration rate, this was exceptionally good performance and served to prove what good, long-term soil management can do.

One of the Heritage contour-planted peach orchards, with alfalfa in the middles.

Ed Clanding's peach orchard on the contour in Gloucester County, N. J.

Carlton Heritage has been replacing old straight-row peach-orchard plantings with rows on the contour for 20 years.

Widespread damage occurred in peach orchards in the county from the hurricane in the fall of 1960 and the very severe cold of this past winter; but there was little injury of any kind in the Heritage orchards.

"When it comes to feeding a tree," Howard senior pointed out, "it's like playing a violin; it's a delicate operation. Soil tests are used as guides, but experience shows that some varieties require more and some less than what the test recommendations indicate."

Every year, the Heritage brothers take out and replace 500 trees. With land values skyrocketing, they have been planting 108 trees to the acre instead of 87. This is being done to increase their production without buying additional land. Both Howard and Carlton

Note:—The author is work unit conservationist, Soil Conservation Service, Clayton, N. J.

feel that, with the use of good management practices and efficient use of water, the land easily will support the additional load.

"The contour-planted orchards on our sloping fields are remarkably uniform," Carlton said. "We believe this to be due to the even distribution of moisture."

They used ryegrass for winter cover until the fall of 1960. Then they tried barley, sown at the rate of 2 to 2½ bushels to the acre. Because it is more easily managed, Howard plans to continue using it. The cover is disked several times in the spring, and then the orchards are worked with a spring-tooth harrow through the summer.

"Weather conditions, especially the amount of rainfall, determine when we stop cultivation," Howard explained. "Generally, it is the latter part of August or early September."

During the picking season, the Heritages pack and hydrocool 400 to 800 bushels daily, depending upon how the fruit ripens.

Howard and Carlton joined in emphasizing that "Farming orchards on the contour on sloping fields may not show immediate returns; but, we have proven to our own satisfaction that it is a paying proposition."

Chemicals vs. the Hoe

In Windbreak Plantations

By Walter T. Bagley

THE "man with the hoe" is disappearing from one of his last strongholds in the Great Plains —the tree-windbreak plantation. Our most successful tree plantings have been those which received timely weedings with the hoe in addition to tractor cultivation.

The advent of miracle chemicals brings hope that the problem of weeds in tree plantings may be solved otherwise, leaving trees free from their competitors for precious moisture, light, and nutrients. Certain herbicides have been developed, which, if properly used, will eliminate the unwanted weeds without injury to newly planted trees. On many sites, their use has increased tree survival and growth.

Chemical spraying completely controlled weeds in this red-cedar row in a Frontier County windbreak.

However, these herbicides can injure and kill trees; hence, an understanding of their limitations is necessary.

In order to assist tree-planting farmers in avoiding the pitfalls which may be encountered in the use of herbicides, soil and water conservation districts in Nebraska are cooperating with the Agricultural Experiment Station in establishing experimental plots. Soil Conservation Service and Extension Service personnel hold demonstrations of methods of herbicide applications and results.

The Frontier County district took the lead in 1960, by providing a sprayer and crew to apply herbicides to cooperators' tree plantings on a contract basis. The success of this operation has stimulated interest throughout the State. Local weed-control districts have been helpful in offering technical assistance and equipment for the program.

The most satisfactory weed control has been obtained with karmex and simazine. One application in the spring generally is enough for the entire growing season. These chemicals are relatively insoluble and leach slowly into the soil profile. Clay and organic matter slow the rate. This is one of the primary reasons why the herbicides can be used in tree plantations. Because the chemicals penetrate more deeply into sandy soils, they are more likely to cause tree injury on these sites. There also are indications that certain species can absorb more herbicides than others without injury. Apparently most trees escape injury because they absorb only small amounts of the chemical, because of their deep and spreading root system.

Herbicides should be applied only to the areas in plantings which normally require hoeing or special equipment for weed control. A band of chemical 3 to 4 feet wide, applied along the tree row, normally is sufficient. Conventional farm implements such as sweeps, spring-tooth harrows, and disks can be used to control the weeds between the rows, but the chemically treated area should not be disturbed. Herbicides can be applied in dry granular form, but spray application has been more successful.

Note:—The author is assistant professor, Department of Horticulture and Forestry, Nebraska Agricultural Experiment Station, Lincoln, Nebr.

Rice *Likes* Wet Feet

By Irving F. Pearce

A 5-year conservation plan on his farm in the South Sutter Soil Conservation District in California is credited by District Director Howard Van Dyke with enabling him to harvest 50 sacks of rice an acre where some of his neighbors get only 30.

Van Dyke, who also is on the Sutter County Agricultural Stabilization and Conservation Committee, owns and operates some 1,200 acres of rice, grain, and row-crop land in the Pleasant Grove area. His crops include rice, barley, wheat, alfalfa, beans, corn, sugar beets, tomatoes, and safflower. He not only has received top production in rice but also has had exceptional per-acre yields from his other crops.

It was 6 years ago that Van Dyke and his neighbors organized their soil conservation district. Technical help was given to district landowners, at the request of the district supervisors, by the Soil Conservation Service technicians, who helped Van Dyke develop a conservation plan for his farm. They mapped the soils and showed Van Dyke how he could use his land within its capabilities and according to its needs.

"In helping me prepare my plan," Van Dyke recalled, "the SCS technicians pointed out the value of many conservation practices, such as crop rotation, crop-residue utilization, green manure, subsoiling, improved irrigation, drainage, and land leveling.

"I found that planting rice or grain year after year is not good. My land requires a change of crops if I am to obtain top production. The main object in a conservation crop rotation is to have soil-improving crops that at least offset soil-depleting crops."

"Along with the rotation of my crops, I work all residues into the surface soil," Van Dyke explained. "I also plant vetch in the fall to be turned under in the spring for green manure. My land needs opening up at times to help break the plowsole; so I subsoil, which helps the roots and water to penetrate through the soil. I have leveled many acres and have constructed a lot of drain ditches."

Observing that since the 88,000-acre South Sutter district was formed in March 1955, more soil and water conservation work has been done by the farmers than in any other comparable area of Sutter County, Van Dyke added:

"When this area obtains more irrigation water which will be impounded by the South Sutter Water District's Camp Far West project, the value of having a district and of being able to obtain technical assistance will be priceless. Assistance will be available to each landowner to help him determine the best method of distributing water over his farm; to show which way the land is to be tipped in leveling so as to fit into the overall drainage plan; the percent of grade; how best to apply the water; and where to construct farm drainage ditches."

Van Dyke likes his conservation farm plan also because it outlines major items for as long as 5 years.

Note:—The author is work unit conservationist, Soil Conservation Service, Yuba City, Calif.

Rice growing under conservation water control in Sutter County, Calif.

SEEDS: The Yearbook of Agriculture. 591 pp. Illus. 1961 Washington, D. C.: U. S. Government Printing Office. $2.

The 1961 Yearbook of Agriculture describes seeds as the basis upon which a progressive agriculture rests, and as the source of most

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of the nourishment which sustains human life. Most crops are grown from seed. New and improved crops are the result of plant breeding and production of quality seeds.

The new Yearbook deals with a subject that is closely related to those of such earlier yearbooks as "Grass," "Trees," and "Plant Diseases," and is a fitting companion to them. Sections dealing with "The Production of Seeds," "The Processing of Seeds," "The Certification of Seeds," and "The Testing of Seeds" describe the important elements that assure the farmer and rancher adequate supplies of high-quality seeds for producing the grain, the feed, and the forage they need to make a living.

The problems and solutions encountered in the production and harvesting of grass and legume seeds are well related, with practical suggestions to the grower of common and specialty seed crops, whether for feed or for conservation use.

Chapters presenting such subjects as seed drying, cleaning, processing, treating, and storing are of special interest to farmers and soil conservationists who know that quality seed is important in producing better crops and effective cover for the land.

Seed certification is essential to maintaining the superior qualities for which a selection or variety has been developed. Methods and certification standards to help maintain these desired qualities are described.

Seed testing has become a science. It furnishes the data for accurately defining, measuring, and labeling seed so that the purchaser may know what he buys, and recognize what good quality seed is. Regulatory measures and law enforcement help materially in bringing seeds of highest quality on the market, thus protecting the purchaser from buying inferior seed.

The numerous authors of the Yearbook are principally professional agriculturists. Appropriately included among them, however, are representatives of the seed trade. They call attention to the responsibilities of seedsmen and describe the four types of seed trade associations by means of which they serve the seed-using public.

The seed field is well covered; the style and appearance of the yearbook are impressive, though more illustrations would have been desirable.

—A. D. Stoesz

SOIL CONDITIONS AND PLANT GROWTH. By E. Walter Russell. 688 pp. Illus. 1961. 9th Edition. Longmans, Green & Co., Inc.: New York. $12.50.

The original book was written in 1912 by E. J. Russell, who was Director of the Rothamsted Experiment Station and later President of the British Association of Soil Science.

The newest edition continues the fine standard set by earlier editions of this widely known and often-quoted book. While this edition follows the general pattern of previous ones, several chapters have been revised or rewritten.

In comparing this edition with the 8th edition, it is noted that chapters V through XVI have been revised in order to reflect the advancements in technology that have taken place in the fields of soil and physical chemistry during the past 10 years.

In addition, the chapter on "Sources of Plant Nutrients in the Soil" has been expanded to include a thorough discussion on the value of phosphate fertilizers and their residual effects.

In the chapter dealing with general ecology of the soil population, the author has included a brief discussion on the use of herbicides and insecticides. It is pointed out that through continued use some chemicals remain in the soil and may build up to such concentrations that potatoes may be tainted. However, soil microorganisms are able to decompose these types of chemicals in nearly all cases.

For the most part, the remainder of the book has not been changed, as the previous edition was completely revised. It is well documented and quotes from nearly 1,500 authors of scientific papers from many parts of the world. It is well written and easily understood. Students of agriculture interested in soils and plants will find this book a valuable reference.

—B. D. Blakely